What is claimed is:

1. A process for preparing adiponitrile by hydrocyanating 1,3-butadiene over a catalyst, by,

- in a first process step, hydrocyanating 1,3-butadiene to 3-pentenenitrile over at least one nickel(0) catalyst and,

- in a second process step, hydrocyanating 3-pentenenitrile to adiponitrile over at least one nickel(0) catalyst with addition of at least one Lewis acid,

which comprises

transferring at least one of the nickel(0) catalysts used in the particular process steps at least partly into the other process step in each case.

2. The process according to claim 1, characterized by the following process steps:

(a) hydrocyanating 1,3-butadiene over at least one nickel(0) catalyst, resulting in a hydrocyanation stream 1 which comprises 3-pentenenitrile, 2-pentenenitrile, 2-methyl-2-butenenitrile, C_9 nitriles, 2-methyl-3-butenenitrile, methylglutaronitrile, the at least one nickel(0) catalyst, unconverted 1,3-butadiene and residues of unconverted hydrogen cyanide,

(b) removing the at least one nickel(0) catalyst from the hydrocyanation stream 1 to obtain a catalyst stream 1 which comprises the at least one nickel(0) catalyst, and a hydrocyanation stream 2 which comprises 3-pentenenitrile, 2-pentenenitrile, 2-methyl-2-butenenitrile, C_9 nitriles and 2-methyl-3-butenenitrile,

(c) regenerating the at least one nickel(0) catalyst in the catalyst stream 1 by reductive nickel catalyst synthesis with addition of fresh ligand to obtain a catalyst stream 2,

(d) hydrocyanating 3-pentenenitrile over at least one nickel(0) catalyst and in the presence of at least one Lewis acid, the nickel(0) catalyst and the Lewis acid stemming at least partly from catalyst stream 2, resulting in a hydrocyanation stream 3 which comprises the at least one nickel(0) catalyst, adiponitrile and the at least one Lewis acid,

(e) removing the at least one nickel(0) catalyst from the hydrocyanation stream

3 by extraction with an organic solvent to obtain a catalyst stream 3 which comprises the at least one nickel(0) catalyst, and a product stream which comprises adiponitrile, and the catalyst stream 3 can be recycled at least partly into process step (a).

3. The process according to claim 2, characterized by the following process steps:

(a) hydrocyanating 1,3-butadiene over at least one nickel(0) catalyst, resulting in a hydrocyanation stream 1 which comprises 3-pentenenitrile, 2-pentenenitrile, 2-methyl-2-butenenitrile, C_9 nitriles, methylglutaronitrile, 2-methyl-3-butenenitrile, the at least one nickel(0) catalyst, unconverted 1,3-butadiene and residues of unconverted hydrogen cyanide,

(a') isomerizing 2-methyl-3-butenenitrile which is present in the hydrocyanation stream 1 to 3-pentenenitrile over at least one nickel(0) catalyst to obtain a 2-methyl-3-butenenitrile-depleted and a 3-pentenenitrile-enriched isomerization stream 1,

(b) removing the at least one nickel(0) catalyst from the isomerization stream 1 to obtain a catalyst system 1 which comprises the at least one nickel(0) catalyst, and a hydrocyanation stream 2 which comprises 3-pentenenitrile, 2-pentenenitrile, 2-methyl-2-butenenitrile, C_9 nitriles and 2-methyl-3-butenenitrile,

(c) regenerating the at least one nickel(0) catalyst in the catalyst stream 1 by reductive nickel catalyst synthesis with addition of fresh ligand to obtain a catalyst stream 2,

(d) hydrocyanating 3-pentenenitrile over at least one nickel(0) catalyst and in the presence of at least one Lewis acid, the nickel(0) catalyst and the Lewis acid stemming at least partly from catalyst stream 2, resulting in a hydrocyanation stream 3 which comprises adiponitrile, the at least one nickel(0) catalyst and the at least one Lewis acid,

(e) removing the at least one nickel(0) catalyst from the hydrocyanation stream 2 by extraction with an organic solvent to obtain a catalyst stream 3 which comprises the at least one nickel(0) catalyst, and a product stream which comprises adiponitrile, and the catalyst stream 3 can be recycled at least partly into process step (a).

4. The process according to claim 3, wherein, in an additional process step (f), the

hydrocyanation stream 2 is separated and a 3-pentenenitrile-rich stream 4 and a 2-methyl-3-butenenitrile-rich stream 5 are obtained.

5. The process according to claim 4, wherein the 3-pentenenitrile-rich stream 4 is conducted into process step (d).

6. The process according to claim 4 or 5, wherein the 2-methyl-3-butenenitrile-rich stream 5 is conducted into process step (a').

7. The process according to any of claims 2 to 6, wherein the process sequence begins with process step (d) in the first run when fresh Lewis acid and fresh nickel(0) catalyst and/or reductively regenerated nickel(0) catalyst are used.

8. The process according to any of claims 2 to 7, wherein 3-pentenenitrile hydrocyanated in process step (d) stems from the hydrocyanation stream 1 or the isomerization stream 1.

9. The process according to any of claims 2 to 8, wherein only a portion of the catalyst stream 2 is used for the hydrocyanation in process step (d) and the remaining portion of the catalyst stream 2 is transferred directly into process step (e) as a bypass stream 1.

10. The process according to any of claims 3 to 8, wherein only a portion of the catalyst stream 2 is used for the hydrocyanation in process step (d) and the remaining portion of the catalyst stream 2 is transferred directly into process step (a') as a bypass stream 1'.

11. The process according to any of claims 3 to 9, wherein only a portion of the catalyst stream 3 is used for the hydrocyanation in process step (a) and the remaining portion of the catalyst stream 3 directly into process step (a') as a bypass stream 2.

12. The process according to any of claims 2 to 11, wherein a fresh and/or reductively regenerated nickel(0) catalyst is fed into process step (c).

13. The process according to any of claims 1 to 12, which is carried out continuously.